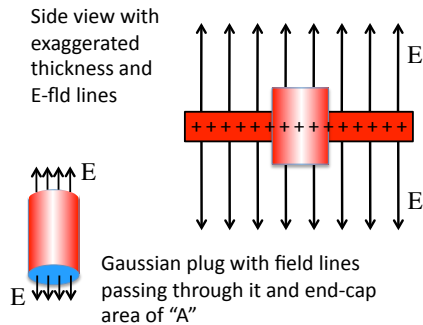


Problem 24.23

Consider a flat, horizontal sheet of charge of area charge density $\sigma = 900 \times 10^{-6} \text{ C/m}^2$. What is the electric field intensity just above the middle of the plate?

There are two ways to do this. The hard way is to use a Gaussian plug (see sketch below) that extends the same distance on either side of the plate, and use Gauss's Law on that plug.

Noting that all of the flux will pass through the two end-caps; noting that flux through one end-cap is EA , where A is the area of the end-cap; and noting that the amount of charge enclosed inside the Gaussian surface is the *charge per unit area* σ times the area of the portion of the plate inside the Gaussian surface, or A , we get:

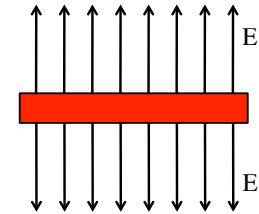


1.)

The easy way to determine this electric field function is to know that the electric field function for an insulating sheet of charge is:

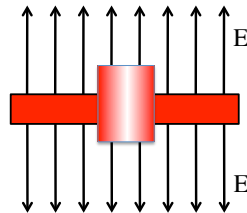
$$E = \frac{\sigma}{2\epsilon_0}$$

Q.E.D.



3.)

$$\begin{aligned} \int_A E dA &= \frac{q_{\text{enc}}}{\epsilon_0} \\ \Rightarrow EA + EA &= \frac{\sigma A}{\epsilon_0} \\ \Rightarrow E &= \frac{\sigma}{2\epsilon_0} \\ &= \frac{(9 \times 10^{-6} \text{ C/m}^2)}{2(8.85 \times 10^{-12} \text{ C}^2 / \text{N} \cdot \text{m}^2)} \\ &= 5.08 \times 10^5 \text{ N/C} \end{aligned}$$



2.)